APPENDIX 5

AIR QUALITY ASSESSMENT

AIR QUALITY ASSESSMENT FROM PROPOSED POULTRYLITTER-FIRED POWER STATION, MUCHEA

REVISION 2a

Prepared for

Blair Fox Generation WA

by

Welker Environmental Consultancy

May 2001

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Client: Blair Fox Generation WA

Report	Version	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
Draft	2	DP	-	e-mail	30/1/2001
Final Draft	2a	DP	CW	e-mail	18/5/2001

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1. INTRODUCTION

Welker Environmental Consultancy has been engaged by Blair Fox Generation to predict the ambient sulphur dioxide, nitrogen oxides, particulate and odour levels from a proposed poultry litter-fired power station at Muchea.

The details of the proposal are provided in the main document and are not repeated in this report.

2. METHODOLOGY

The methodology used in this report to predict ambient levels of air contaminants was to use the "Ausplume" computer model. Ausplume is a gaussian dispersion model developed and maintained by the Environment Protection Authority of Victorian (EPAV 1985), and is widely used throughout Australia. Ambient levels predicted by modelling can then be compared against criteria for acceptable levels.

Key site specific assumptions incorporated into the modelling are:

- a site roughness of 0.4 metres; and
- the effects of topography on dispersion have not been included as the region around the proposed site is reasonably flat.

3. METEOROLOGICAL DATA

The proposed power station is located about 25-30 km from the coast. A meteorological data set suitable for dispersion modelling and representative of this location has been derived from the DEP monitoring site at Caversham (20 kilometres from the coast).

The Caversham meteorological data is for the 1994 year, and consists of 1-hourly averaged wind speed, wind direction, sigma theta, temperature, stability class and mixing height in Ausplume-compatible form.

4. NEAREST RESIDENCES

The locations of the residences up to 3 km north and south, and 1.5 km east and west, of the site for the proposed power station are shown in Table 1.

Table 1 Locations of nearest residences

AMG Easting (m)	AMG Northing (m)
399583	6512926
399555	6512804
400031	6511945
400056	6511769
400098	6511673
400122	6511531
400476	6511461
401551	6507932
401912	6508091

5. AIR EMISSIONS

The main air emissions from the proposed power station are from two sources:

- sulphur dioxide, nitrogen oxides and particulates from a chimney stack serving the boiler; and
- odours from the shed containing the poultry litter.

It is assumed in the remainder of this report that all particulate matter is PM10. This assumption is conservative (ie will over-estimate ambient levels of air contaminants in relation to criteria).

6. APPLICABLE AIR CONTAMINANT CRITERIA

6.1 SULPHUR DIOXIDE, NITROGEN DIOXIDE, PARTICULATES AND HYDROCHLORIC ACID

In June 1998, the National Environment Protection Council (NEPC) endorsed the National Environment Protection Measure for Ambient Air Quality. The Measure includes standards for air quality. The goals of the Measure are for the standards to be within the maximum allowable exceedences by 2008 (NEPC 1998) at performance monitoring stations. The standards and goals for sulphur dioxide, nitrogen dioxide and particles (as PM10) are shown in Table 2 (NEPC 1998).

The criterion used for hydrochloric acid is the Californian Reference Exposure Level (CAPCOA 1993) which was used very recently for the assessment of the Global Olivine proposal (Barker & Associates Ltd 2000).

Table 2 Ambient air quality criteria

Contaminant	Concentration	Averaging time	Maximum allowable exceedences
Sulphur dioxide	0.20 ppm (≈572 μg/m^3)	1 hour	1 day a year
	0.08 ppm (≈229 μg/m^3)	1 day	1 day a year
	0.02 ppm (≈57 μg/m^3)	1 year	none
Nitrogen dioxide	0.12 ppm (≈246 μg/m^3)	1 hour	1 day a year
	0.03 ppm (≈62 μg/m^3)	1 year	none
Particles as PM10	50 μg/m^3	1 day	5 days a year
Hydrochloric acid	3000 μg/m^3	1 hour	none

6.2 ODOURS

Since 1994, the Environmental Protection Authority (EPA) and Department of Environmental Protection (DEP) have preferred the use of quantitative odour assessment for predicting odour impacts from new developments.

Quantitative odour assessment makes use of a numerical criterion which defines unacceptable odour impacts, in the same way that conventional air quality "standards" are used to define an unacceptable risk of a health impact.

The measurement of odours however, cannot, as yet, be directly performed using instrumentation, because no instrument has been developed which responds to odour in the same way as the human olfactometry system. Assessment of odour impacts is therefore based on odour measurements using "dynamic olfactometry".

Dynamic olfactometry is the term used to describe the measurement of odour by presenting a sample of odorous air to a panel in a range of dilutions and seeking a response from the panellists on whether they can detect the odour. The correlations between the known dilution ratios and the panellists' responses are used to calculate the number of dilutions of the original sample required to achieve the odour threshold. The odour concentration of the sample is expressed in "odour units per cubic metre of air" (OU/m^3). References to odour units in this report based on the NVN2820 olfactometry method using forced choice certainty thresholds.

The EPA has recently released a draft guidance note for the assessment of odours in which it states that "an appropriate guideline for poultry odours is 7 OU/m^3, 99.9 percentile, 1-hour average" (EPA 2000). This guideline applies at odour-sensitive land uses which include residential, hospitals, hotels, caravan parks, schools, aged care facilities, child care facilities, shopping centres, play grounds, recreational centres etc.

7. STACK EMISSIONS

The emissions parameters, based on information provided by the proponent, for the boiler stack of the proposed power station are shown in Table 3.

Table 3 Poultry litter power generation plant main stack emission parameters

Parameter	Value
Stack height above ground (m)	40
Location (AMG mE, mN)	400889, 6510178
Exit volume at exit temperature (m^3/hour) (m^3/s)	112,000 31
Exit velocity (m/s)	15
Exit temperature (C)	200
Height of boilerhouse above ground (m)	30
Width of boilerhouse (m)	40

The emissions from the boiler stack of the proposed power station are shown in Table 4.

Table 4 Expected emissions from proposed Western Australian plant

Substance	Typical emissions		Worst case emission estimates		
	Concentration[(g)]	Rate (g/s)[(f)]	Concentration[(g)]	Rate (g/s)[(f)]	Frequency (hours/year)
Oxides of nitrogen (as NO_2)	258	4.6	387[(c)]	6.9	24[(i)]
Carbon monoxide	47	0.8	70[(c)]	1.3	24[(i)]
Sulphur dioxide[(a)]	185[(b)]	3.3	1230[(h)]	22.0	<1[(j)]
Hydrogen chloride	270	4.8	410[(c)]	7.3	24[(i)]
Particulates[(d)]	60[(c)]	1.1	80	1.4	<1[(k)]
Dioxins and furans	0.1	1.79E-09	0.1	1.79E-09	continuous
Arsenic[(e)]	0.0027	6.44E-05	0.0036	4.83E-05	<1[(k)]
Cadmium[(e)]	0.00003	7.16E-07	0.00004	5.37E-07	<1[(k)]
Chromium[(e)]	0.00042	1.00E-05	0.00056	7.52E-06	<1[(k)]
Copper[(e)]	0.024	5.73E-04	0.032	4.30E-04	<1[(k)]
Mercury[(e)]	<0.000003	7.16E-08	<0.000004	5.37E-08	<1[(k)]
Lead[(e)]	0.00066	1.58E-05	0.00088	1.18E-05	<1[(k)]
Nickel[(e)]	0.00072	1.72E-05	0.00096	1.29E-05	<1[(k)]
Zinc[(e)]	0.084	2.00E-03	0.112	1.50E-03	<1[(k)]

(a) Based on expected S in Western Australian poultry litter of 0.3%.

(b) Based on assumed 85% removal of S into flyash for identical UK plant – see Attachment 1 in facsimile from Blair Fox to DEP dated 19/12/2000.

(c) Based on HMIP licence for UK plant in which the maximum daily level (ie. bag filter design maximum concentration = worst case emission) is 1.3 times the 7-day (ie. long-term) level.

(d) Based on bag filter design maximum concentration of 80 mg/Nm^3.

(e) Based on metal composition in poultry ash (see Appendix 3) x TSP emission concentration.

(f) Based on volume flow of 17.9 Nm^3/s for proposed plant.

(g) All concentrations in mg/Nm^3 except for dioxins in ng I-TEQ/Nm^3

(h) Based on 0% removal of S into flyash.

(i) Based on the assumption that the UK plant complies with its licence conditions and reaches the limit one day per year.

(j) Based on assumption that 0% removal of S into flyash is unlikely to ever be achieved.

(k) Based on the assumption that the UK plant complies with its particulate emissions licence limit and an exceedence is unlikely.

The “worst case emission” estimates have been made to satisfy DEP requests for modelling the worst case environmental impacts. The frequency of emissions at these levels will need to be confirmed by operating experience and monitoring.

Emissions from the Tiwest main stack supplied by the proponent (see Table 5) have also been included in the modelling because the Tiwest synthetic rutile plant is in proximity to the proposed power station.

Table 5 Tiwest main stack emissions

Parameter	Value
Stack height above ground (m)	58
Location (AMG mE, mN) Sulphur dioxide emission rate (licence limit) (g/s)	401691, 6510589 85
Particulates concentration (licence limit) (mg/m^3)	250
Particulates emission rate (g/s)	5.5
NOx concentration (mg/Nm^3)	90
NOx emission rate (g/s)	2.0
Exit volume at exit temperature (m^3/s) Exit velocity (m/s)	22 11
Exit temperature (C)	80

Note: Tiwest do not emit any hydrochloric acid.

8. SHED EMISSIONS

The details of the shed for housing the poultry litter provided by the proponent are shown in Table 6.

The initial horizontal and vertical widths of the plume selected for modelling was one-quarter of the building width[1] and building height respectively in accordance with Ausplume guidelines. The initial plume release height was at the mid-point of the height of the louvres.

Table 6 Poultry litter power generation plant litter storage building emission parameters

Parameter	Value
Location (AMG mE, mN)	400889, 6510178
Volume of litter (m^3)	5000 (approx)
Surface area of litter stockpile (m^2)	1559 (max)
Building dimensions (length x width x height) (m)	87.6 x 40.9 x 14
Height of side louvres above ground (m)	2
Side louvre dimensions (length x height) (m)	22 x 1

The calculation of odour emissions from the litter stockpile was based on emission rate measurements given in CH2M Hill (1997) for compost sources in operating facilities in Perth. The data relevant to this study are shown in Table 7.

[1] Defined as the minimum of the building length and width.

Table 7 Specific odour emissions rates for chicken litter

Source	Specific odour emissions rate ($OU/m^2/s$)[a]
Chicken litter (20 minutes after turning)	72
Chicken litter (50 minutes after turning)	58
Chicken litter (stable)	43

[a] Adjusted for 0.3 m/s wind speed which is considered to be appropriate for uneven surfaces such as stockpiles (CH2M Hill 1997).

This study has used the most conservative specific odour emission rate of 72 OU/s. The total odour emission rate (OER) from the stockpile is estimated to be 112,248 OU/s.

The precise distribution of odours within the shed will depend on many factors including the nature, amount, moisture content and age of litter, and the level of agitation from handling at any point in time. For this study, it has been simply assumed that the odour is uniformly distributed within the air inside the shed.

The amount of odour actually emitted from the shed will depend on the air ventilation rate into the shed. Since the air intake into the boiler will be located above the litter stockpile, a portion of the air inside the shed will be drawn into the boiler and combusted this eliminating the odour.

The air intake into the boiler is about 45,000 m^3/hr (12 m^3/s).

Ventilation through the shed will range from 45,000 m^3/h to 225,000 m^3/h (62 m^3/s) and will primarily occur through louvres running down the sides. The area of the opening along each side is 22 m^2. The ventilation rate will be at a maximum when the wind is blowing directly into the side of the shed and the louvres are fully open.

The fraction of the total odour generated within the shed that is actually emitted from the shed can be determined from the maximum ventilation rate based on wind speed, and the proportion of the air emitted from the shed after allowing for the boiler intake. The resulting OERs based on wind speed are shown in Table 8.

Table 8 Variation in OER for wind speed and ventilation rate

Wind speed range (m/s)	Maximum potential ventilation air into shed (m^3/s)	Maximum actual ventilation air into shed[a] (m^3/s)	Fraction of odour from stockpile actually emitted from shed	OER (OU/s)
0 – 0.75	16	16	0.24	27,000
0.75 – 1.5	33	33	0.62	69,000
1.5 – 3.0	66	62	0.80	90,000
3.0 – 6.0	68	62	0.80	90,000
6.0 – 9.0	113	62	0.80	90,000
>9.0	238	62	0.80	90,000

[a] The louvres will be closed during high wind speeds to prevent air velocities that could cause internal airborne dust to reach excessive levels.

In summary, conservative assumptions which have been employed in the modelling include:

- using the highest odour emission rate in the literature for litter (ie the rate for 20 minutes after turning) as a continuous emission from the stockpile;

- using the highest wind speed in the wind speed ranges up to 3.0 m/s to calculate OERs in Table 7; and
- for the wind speed ranges up to 3.0 m/s, assuming the maximum possible ventilation rates into the shed through the louvres irrespective of actual wind direction.

Once the facility is operational procedures can be modified to ensure that the side louvres can be fully or partially closed if odour emissions arising from high ventilation rates cause adverse impacts. This would direct a greater portion of the ventilation air in the shed into the boiler, and reduce odour emissions from the shed.

9. PREDICTED AMBIENT LEVELS OF AIR CONTAMINANTS

9.1 SULPHUR DIOXIDE, NITROGEN DIOXIDE, PARTICULATES AND HYDROCHLORIC ACID

The maximum predicted ground level concentrations from modelling sulphur dioxide, nitrogen dioxides and PM10 using the worst case emissions rates in Table 3 are summarised in Table 9. It should be noted that these concentrations do not include areas within the Tiwest lease boundary and, where applicable, have taken into account second highest days as in the NEPM criterion. This was in response to a DEP request in relation to the applicability of emissions limits (based on whether the maximum predicted concentration exceeded 50% of the criterion).

Contours for the cumulative maximum 1-hour average sulphur dioxide concentrations are shown in Figure 1.

Table 9 Highest predicted cumulative concentrations

Contaminant	Maximum predicted concentration [a]	Location (AMG mE, mN)	Contribution from the proposal (%)	Fraction of criterion (%)	Criteria	
					Concentration	Averaging time
Sulphur dioxide	308 $\mu g/m^3$ [c]	401800, 6511300	0	**54**	0.20 ppm (≈572 $\mu g/m^3$) [c]	1 hour
	100 $\mu g/m^3$ [c]	400600, 6510100	57	**44**	0.08 ppm (≈229 $\mu g/m^3$) [c]	1 day
	20 $\mu g/m^3$	402200, 6511300	3	**34**	0.02 ppm (≈57 $\mu g/m^3$)	1 year
Nitrogen dioxide[b]	26 $\mu g/m^3$ [c]	400800, 6510100	100	**11**	0.12 ppm (≈246 $\mu g/m^3$) [c]	1 hour
	1.5 $\mu g/m^3$	401000, 6510300	93	**2**	0.03 ppm (≈62 $\mu g/m^3$)	1 year
Particles as PM10	6.6 $\mu g/m^3$	400600, 6510100	48	**13**	50 $\mu g/m^3$	1 day

[a] Excludes within the Tiwest lease boundary.
[b] Conservatively assumes that 50% of NOx from both Tiwest and the proposal is or becomes NO2.
[c] Second highest day per year.

The maximum predicted ground level concentrations of all contaminants are less than 50% of the NEPM criteria except for the maximum 1-hour sulphur dioxide concentration. In this case, the maximum predicted concentration is 54% of the NEPM criterion, however, this event is attributable to Tiwest only since the contribution from the proposal to this event is zero.

The results from modelling sulphur dioxide, nitrogen dioxides and PM10 using the worst case emissions rates in Table 9 for the proposal only are summarised in Table 10.

Table 10 Highest predicted concentrations from proposal only

Contaminant	Maximum predicted concentration anywhere	Fraction of criterion (%)	Criteria	
			Concentration	Averaging time
Sulphur dioxide	173 µg/m^3	**30**	0.20 ppm (≈572 µg/m^3) [a]	1 hour
	82 µg/m^3	**36**	0.08 ppm (≈229 µg/m^3)	1 day
	9.0 µg/m^3	**16**	0.02 ppm (≈57 µg/m^3)	1 year
Nitrogen dioxide[b]	27 µg/m^3	**11**	0.12 ppm (≈246 µg/m^3) [a]	1 hour
	1.4 µg/m^3	**2**	0.03 ppm (≈62 µg/m^3)	1 year
Particles as PM10	5.2 µg/m^3	**10**	50 µg/m^3	1 day
Hydrochloric acid	57 µg/m^3	**2**	3000 µg/m^3	1 hour

(a) Second highest day per year.
(b) Conservatively assumes that 50% of NOx from the proposal is NO2.

The maximum predicted ground level concentrations of all contaminants from the proposal in isolation are less than 50% of the criteria levels for all contaminants.

9.2 ODOURS

The contour for the 7 OU 1-hour average 99.9 percentile criterion odour level is shown in Figure 4. All of the nearby residences lie outside the contour, which demonstrates that this criterion is also met.

Details of the modelling parameters and assumptions for the stacks and shed odours are shown in Appendix 1 and Appendix 2 respectively.

10. REFERENCES

Barker & Associates Ltd, 2000, “Waste to Energy & Water Plant, Lot 15 Mason Rd Kwinana, Western Australia”.

California Air Pollution Control Officers Association, 1993, “Air Toxics ‘Hot Spots’ Program – Revised 1992 Risk Assessment Guidelines”.

CH2M Hill, 1997, “Odour Impact Modelling – Composting Facility, Perth, WA”.

Environmental Protection Authority of Victoria (EPAV), 1985, “Plume Calculation Procedure an approved procedure under Schedule E of the State Environment Protection Policy (The Air Environment)”, Publication 210, March 1985.

Environmental Protection Authority (EPA), 2000, “Guidance for the Assessment of Environmental Factors – Assessment of Odour Impacts – Draft”, No 47, April 2000.

National Environment Protection Council (NEPC), 1998, “National Environment Protection Measure for Ambient Air Quality”, 26 June 1998.

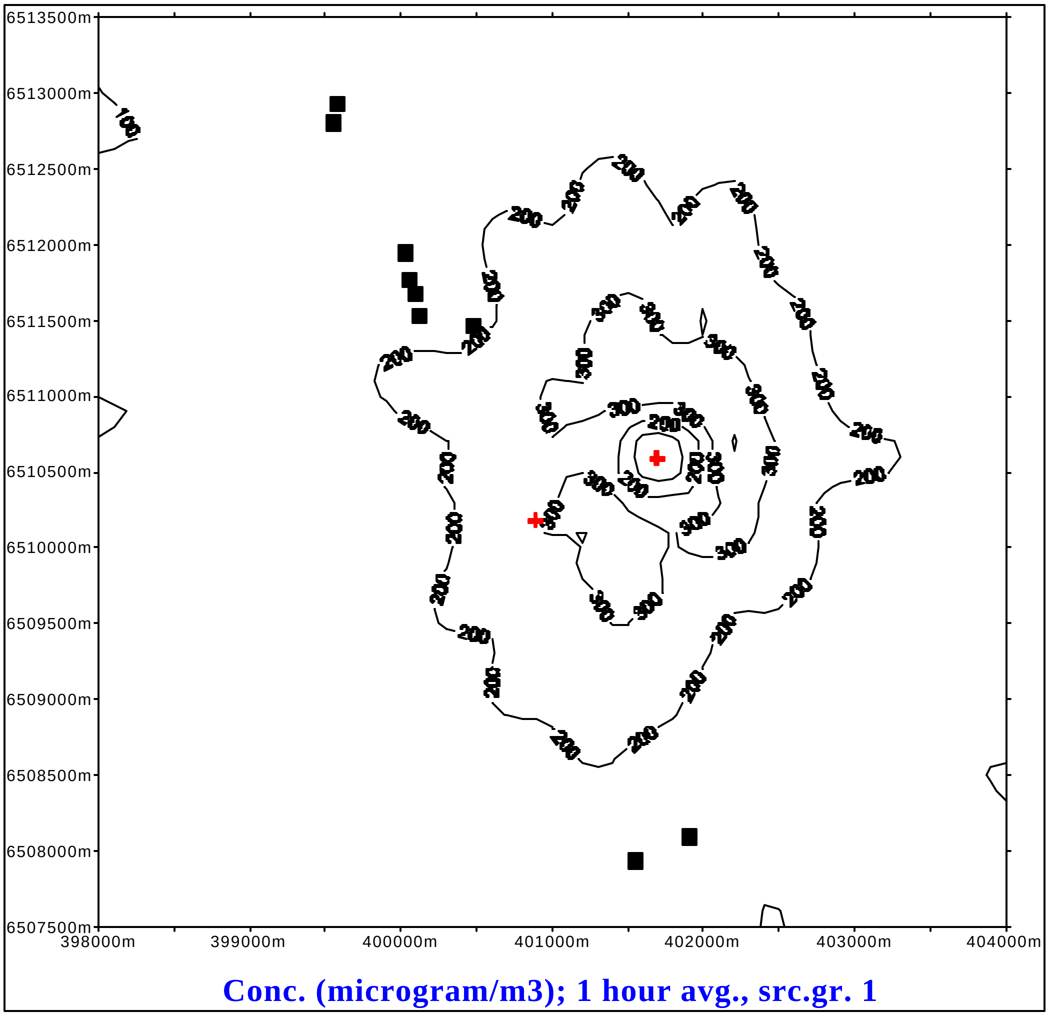

Figure 1 Predicted cumulative maximum 1-hour average sulphur dioxide concentrations

Notes:

- Criterion is 572 µg/m^3 (second highest day)
- Crosses show source locations
- Blocks show residence locations

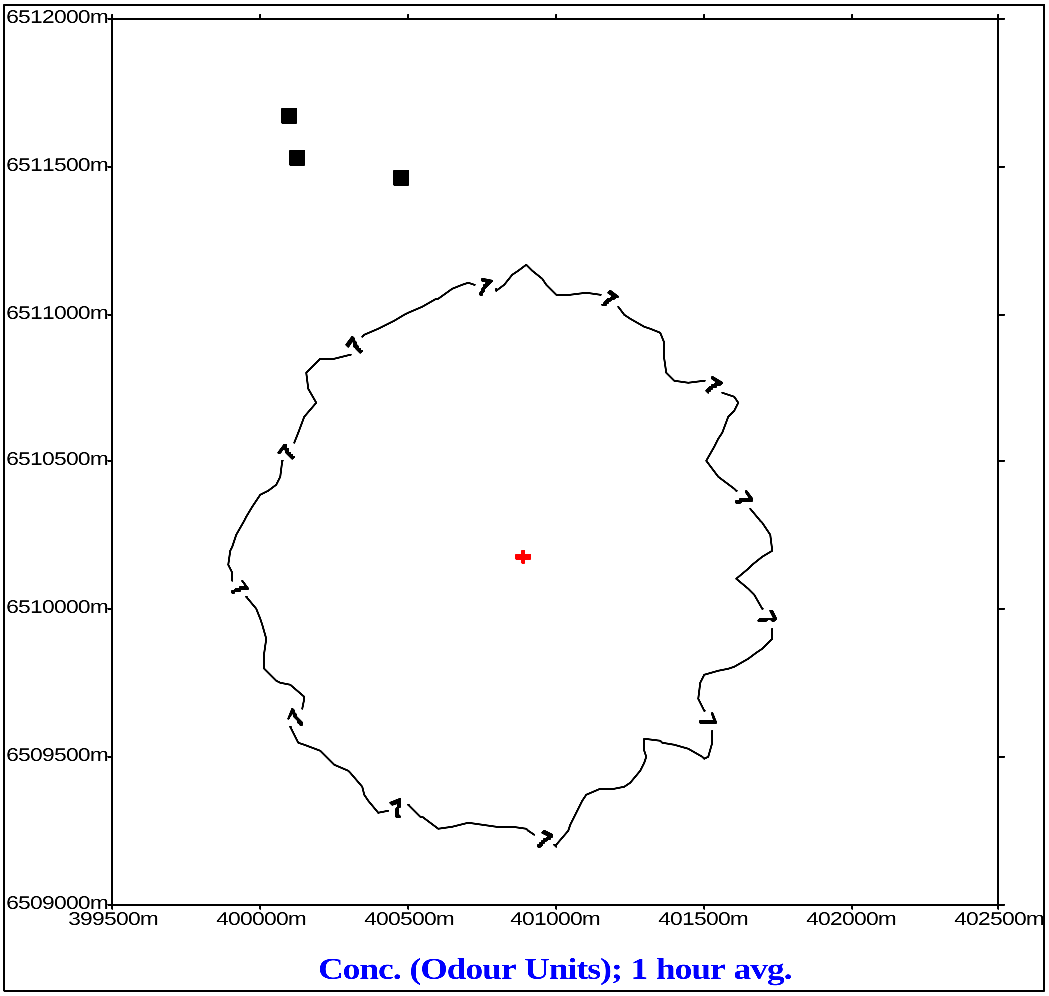

Figure 2 Predicted 7 OU 1-hour average 99.9 percentile odour concentrations

Notes:

- Crosses show source locations
- Blocks show residence locations

Appendix 1 Ausplume parameters for stack emissions

Ausplume version 4.0

Concentration or deposition	Concentration
Emission rate units	grams/second
Concentration units	microgram/m3
Units conversion factor	1.00E+06
Background concentration	0.00E+00
Terrain effects	None
Smooth stability class changes?	No
Other stability class adjustments ("urban modes")	None
Ignore building wake effects?	No
Decay coefficient (unless defined in met. file)	0.000
Anemometer height	10 m

DISPERSION CURVES

Horizontal dispersion curves for sources <100m high	Pasquill-Gifford
Vertical dispersion curves for sources <100m high	Pasquill-Gifford
Horizontal dispersion curves for sources >100m high	Briggs Rural
Vertical dispersion curves for sources >100m high	Briggs Rural
Enhance horizontal plume spreads for buoyancy?	Yes
Enhance vertical plume spreads for buoyancy?	Yes
Adjust horizontal P-G formulae for roughness height?	Yes
Adjust vertical P-G formulae for roughness height?	Yes
Roughness height	0.400m
Adjustment for wind directional shear	None

PLUME RISE OPTIONS

Gradual plume rise?	Yes
Stack-tip downwash included?	Yes
Building downwash algorithm:	Schulman-Scire
Entrainment coeff. for neutral & stable lapse rates	0.60,0.60
Partial penetration of elevated inversions?	No
Disregard temp. gradients in the hourly met. file?	Yes

and in the absence of boundary-layer potential temperature gradients given by the hourly met. file, a value from the following table (in K/m) is used:

Wind Speed Category	Stability Class A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

WIND SPEED CATEGORIES
Category boundaries (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS
"Irwin Rural" values (hourly met. file values IGNORED)

AVERAGING TIMES
1 hour
24 hours
average over all hours

Poultry Litter Power Plant (Stack) Revised Jan 2001

SOURCE GROUPS

Group No. Members

1	StSO2	TiSO2
2	StNOx	TiNOx
3	StPM	TiPM
4	StSO2	
5	StNOx	
6	StPM	

Poultry Litter Power Plant (Stack) Revised Jan 2001

SOURCE CHARACTERISTICS

Stack Source: StSO2

X(m)	Y(m)	Ground Elev.	Stack Height	Diam.	Temp.	Speed
400889	6510178	0m	40m	1.60m	200C	15.0m/s

______ Effective building dimensions (in metres) ______

Wind dir.	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Width	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Height	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0

Wind dir.	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Width	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Height	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0

Wind dir.	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Width	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Height	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0

(Constant) emission rate = 2.20E+01 grams/second
No gravitational settling or scavenging.

Stack Source: TiSO2

X(m)	Y(m)	Ground Elev.	Stack Height	Diam.	Temp.	Speed
401691	6510589	0m	58m	1.60m	80C	11.3m/s

No building wake effects.
(Constant) emission rate = 8.50E+01 grams/second
No gravitational settling or scavenging.

Stack Source: StNOx

X(m)	Y(m)	Ground Elev.	Stack Height	Diam.	Temp.	Speed
400889	6510178	0m	40m	1.60m	200C	15.0m/s

______ Effective building dimensions (in metres) ______

Wind dir.	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Width	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Height	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0

Wind dir.	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Width	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Height	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0

Wind dir.	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Width	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Height	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0

(Constant) emission rate = 6.90E+00 grams/second
No gravitational settling or scavenging.

Stack Source: TiNOx

X(m)	Y(m)	Ground Elev.	Stack Height	Diam.	Temp.	Speed
401691	6510589	0m	58m	1.60m	80C	11.3m/s

No building wake effects.
(Constant) emission rate = 2.00E+00 grams/second
No gravitational settling or scavenging.

Stack Source: StPM

X(m)	Y(m)	Ground Elev.	Stack Height	Diam.	Temp.	Speed
400889	6510178	0m	40m	1.60m	200C	15.0m/s

______ Effective building dimensions (in metres) ______

Wind dir.	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Width	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Height	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0

Wind dir.	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Width	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Height	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0

Wind dir.	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Width	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Height	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0

(Constant) emission rate = 1.40E+00 grams/second
No gravitational settling or scavenging.

Stack Source: TiPM

X(m)	Y(m)	Ground Elev.	Stack Height	Diam.	Temp.	Speed
401691	6510589	0m	58m	1.60m	80C	11.3m/s

No building wake effects.
(Constant) emission rate = 5.50E+00 grams/second
No gravitational settling or scavenging.

Poultry Litter Power Plant (Stack) Revised Jan 2001

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
398000.m 398200.m 398400.m 398600.m 398800.m 399000.m 399200.m
399400.m 399600.m 399800.m 400000.m 400200.m 400400.m 400600.m
400800.m 401000.m 401200.m 401400.m 401600.m 401800.m 402000.m
402200.m 402400.m 402600.m 402800.m 403000.m 403200.m 403400.m
403600.m 403800.m 404000.m

and these y-values (or northings):
6507500.m 6507700.m 6507900.m 6508100.m 6508300.m 6508500.m 6508700.m
6508900.m 6509100.m 6509300.m 6509500.m 6509700.m 6509900.m 6510100.m
6510300.m 6510500.m 6510700.m 6510900.m 6511100.m 6511300.m 6511500.m
6511700.m 6511900.m 6512100.m 6512300.m 6512500.m 6512700.m 6512900.m
6513100.m 6513300.m 6513500.m

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	Elevn	Height	No.	X	Y	Elevn	Height
1	400098	6511673	0.0	0.0	6	400031	6511945	0.0	0.0
2	400122	6511531	0.0	0.0	7	400056	6511769	0.0	0.0
3	400476	6511461	0.0	0.0	8	401551	6507932	0.0	0.0
4	399583	6512926	0.0	0.0	9	401912	6508091	0.0	0.0
5	399555	6512804	0.0	0.0					

Meteorological data file information:
Caversham 1994 Blockley 271200. Read ca94aus.rea for details.

Appendix 2 Ausplume parameters for shed emissions

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                         Ausplume version 4.0
                         ____________________

                  Poultry Litter Power Plant (Odour)
                  _____________________________________

Concentration or deposition                          Concentration
Emission rate units                                  OUV/second
Concentration units                                  Odour Units
Units conversion factor                              1.00E+00
Background concentration                             0.00E+00
Terrain effects                                      None
Smooth stability class changes?                      No
Other stability class adjustments ("urban modes")    None
Ignore building wake effects?                        No
Decay coefficient (unless defined in met. file)   0.000
Anemometer height                                     10 m

                   DISPERSION CURVES
Horizontal dispersion curves for sources <100m high  Pasquill-Gifford
Vertical  dispersion  curves for sources <100m high  Pasquill-Gifford
Horizontal dispersion curves for sources >100m high  Briggs Rural
Vertical  dispersion  curves for sources >100m high  Briggs Rural
Enhance horizontal plume spreads for buoyancy?       No
Enhance  vertical  plume spreads for buoyancy?       No
Adjust horizontal P-G formulae for roughness height? Yes
Adjust  vertical  P-G formulae for roughness height? Yes
Roughness height                                     0.400m
Adjustment for wind directional shear                None

                    PLUME RISE OPTIONS
Gradual plume rise?                                  No
Stack-tip downwash included?                         No
Building downwash algorithm:                        Schulman-Scire
Entrainment coeff. for neutral & stable lapse rates 0.60,0.60
Partial penetration of elevated inversions?          No
Disregard temp. gradients in the hourly met. file?   Yes

and in the absence of boundary-layer potential temperature gradients
given by the hourly met. file, a value from the following table
(in K/m) is used:

   Wind Speed                Stability Class
    Category       A      B      C      D      E      F
  ______________________________________________________
      1          0.000  0.000  0.000  0.000  0.020  0.035
      2          0.000  0.000  0.000  0.000  0.020  0.035
      3          0.000  0.000  0.000  0.000  0.020  0.035
      4          0.000  0.000  0.000  0.000  0.020  0.035
      5          0.000  0.000  0.000  0.000  0.020  0.035
      6          0.000  0.000  0.000  0.000  0.020  0.035

WIND SPEED CATEGORIES
Category boundaries (in m/s) are:  0.75,  1.50,  3.00,  6.00,  9.00

WIND PROFILE EXPONENTS
"Irwin Rural" values (hourly met. file values IGNORED)

AVERAGING TIMES
 1 hour

______________________________________________________________________

                  Poultry Litter Power Plant (Odour)

                        SOURCE CHARACTERISTICS
                  _____________________________________
```

Volume Source: Shed

X(m)	Y(m)	Ground ht.	Source ht.	Hor. spread	Vert. spread
400889	6510178	0m	14m	10m	4m

Emission rates by stability and wind speed, in OUV/second:

Wind (m/s)	< 0.8	0.8- 1.5	1.5- 3.0	3.0- 6.0	6.0- 9.0	> 9.0
Stability A	2.72E+04	6.96E+04	8.98E+04	8.98E+04	8.98E+04	8.98E+04
Stability B	2.72E+04	6.96E+04	8.98E+04	8.98E+04	8.98E+04	8.98E+04
Stability C	2.72E+04	6.96E+04	8.98E+04	8.98E+04	8.98E+04	8.98E+04
Stability D	2.72E+04	6.96E+04	8.98E+04	8.98E+04	8.98E+04	8.98E+04
Stability E	2.72E+04	6.96E+04	8.98E+04	8.98E+04	8.98E+04	8.98E+04
Stability F	2.72E+04	6.96E+04	8.98E+04	8.98E+04	8.98E+04	8.98E+04

No gravitational settling or scavenging.

Poultry Litter Power Plant (Odour)

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
399500.m 399600.m 399700.m 399800.m 399900.m 400000.m 400100.m
400200.m 400300.m 400400.m 400500.m 400600.m 400700.m 400800.m
400900.m 401000.m 401100.m 401200.m 401300.m 401400.m 401500.m
401600.m 401700.m 401800.m 401900.m 402000.m 402100.m 402200.m
402300.m 402400.m 402500.m

and these y-values (or northings):
6509000.m 6509100.m 6509200.m 6509300.m 6509400.m 6509500.m 6509600.m
6509700.m 6509800.m 6509900.m 6510000.m 6510100.m 6510200.m 6510300.m
6510400.m 6510500.m 6510600.m 6510700.m 6510800.m 6510900.m 6511000.m
6511100.m 6511200.m 6511300.m 6511400.m 6511500.m 6511600.m 6511700.m
6511800.m 6511900.m 6512000.m

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	Elevn	Height	No.	X	Y	Elevn	Height
1	400098	6511673	0.0	0.0	3	400476	6511461	0.0	0.0
2	400122	6511531	0.0	0.0					

Appendix 3 Characteristics of poultry litter ash

January 05, 2001

Dear Mr Rosser

In reply to your facsimile dated 4th December 2000, I can provide the following information.

The ash material has a high nutrient content in terms of phosphorus (P) and potassium (K), with ash contents of these nutrients over 9% on a weight basis. There are smaller concentrations of Ca, Mg and S that are also essential nutrients for crops. In addition, the material contains useful concentrations of copper (Cu) and zinc (Zn) that are essential micronutrients for crops.

Assuming the material is to be used as a phosphatic fertiliser, typical application rates to soils would vary depending on the agricultural system into which the ash is marketed. The material has a similar P concentration to that found in single super-phosphate, and after supplementation with additional sulphur (S), would probably find a useful market in the pasture and grazing industries.

Typical application rates for P fertilisers on pastures vary from 5-30 kg P/ha/yr, so that likely application rates for the ash material are in the range 55-330 kg/ha/yr.

Concentrations of heavy metals as noted in your facsimile were as follows:

Arsenic (As) 45 mg/kg

Cadmium (Cd) 0.5 mg/kg

Chromium (Cr) 7 mg/kg

Copper (Cu) 400 mg/kg

Mercury (Hg) < 0.05 mg/kg

Lead (Pb) 11 mg/kg

Nickel (Ni) 12 mg/kg

Zinc (Zn) 1400 mg/kg

It has been suggested by the WA Department of Environmental Protection that a Toxicity Characteristic Leaching Procedure (TCLP) test be performed on the material. I believe this to be an inappropriate procedure to assess risks from heavy metals in the material when it is used as a fertiliser on agricultural soils. The TCLP test (US EPA Method 1311) is designed to simulate the leaching a waste will undergo if disposed to a landfill. As pointed out in the USA EPA notes to this procedure "the test is designed to simulate leaching that takes place in a sanitary landfill only". It involves the extraction of the waste with acetic acid for 18 hours. Such a procedure is inappropriate to assess the suitability of a material when the intended use is on agricultural soils for crop and animal production.

In terms of use on agricultural soils, the heavy metal of most concern is cadmium (Cd), due to the possibility of transfer of this element through the food chain. All States in Australia have regulations governing concentrations of impurities in fertilisers or soil amendments. For example in Western Australia, concentrations of cadmium (Cd) in fertilisers are covered under the Fertiliser Act (1977) amendments 1984, where a phosphatic fertiliser cannot contain in excess of 500 mg Cd per kg P (due to be reduced to 300 mg Cd/kg P in the near future). Under the Act, the ash material would be classed as a phosphatic fertiliser, with the Cd concentration on a per unit P basis around 5 mg Cd/kg P, almost 100 times lower than the present limit value as prescribed under the

Fertiliser Act. Indeed, this ash material has a lower Cd concentration that most other manufactured phosphatic fertilisers marketed in Australia and could be classed as an extremely "clean" product from a cadmium viewpoint.

In terms of other heavy metals, the following comments apply.

Arsenic - As concentrations in fertilisers are currently not regulated in WA or any other State. Typical concentrations of As in commercially used phosphate rocks for fertiliser manufacture vary from 5 to 200 mg/kg, but are usually less than 10 mg/kg. Typical concentrations of As found in unpolluted agricultural soils vary from 1-20 mg/kg. Amounts of As added to agricultural soils through use of bisolids (sewage sludge) are regulated in some States (no guidelines available yet in WA). Maximum permitted concentrations of As in biosolids used on soils for food production are generally set at a value of 20 mg/kg in most States, recognising that biosolids are added to soil in large amounts (usually several tonnes per hectare). South Australia has an annual loading limit of 70 g/ha.

Assuming the poultry litter ash is added at a maximum rate of 400 kg/ha, which would be considered a high rate of P application (37 kg P/ha) not required each and every year to most pasture soils, annual loadings of As to soils would be 18 g/ha.

This figure is well under the SA annual loading limit for biosolids. Assuming a typical WA soil has a background As concentration of 5 mg/kg, it would take over 360 years of repeated annual applications of poultry ash to double the background As concentration. It would take over 1000 years to raise the soil concentration to the current Environmental Investigation Level (20 mg/kg) as determined by the recent National Environmental Protection Measure (NEPM), or until the amounts of As added exceeded the Cumulative Contaminant Loading Limit for As as set out in the National Water Quality Management Strategy Guidelines for agricultural irrigation water quality. Thus, it appears that As in the material is not a major threat to soil or food quality.

Chromium, mercury, lead and nickel - concentrations are low enough in the material to ignore in terms of environmental or food chain risks. Concentrations of these elements are within the range of normal concentrations currently found in agricultural soils. Copper and zinc - these elements are essential micronutrients often added as a supplement to other fertilisers at 0.1% to 1% levels. The concentrations in the poultry ash are therefore of no concern but add to the commercial value of the product. If you wish to discuss any of the above information, please do not hesitate to call me on 08 8303 8433 or 0409 693 906.

Sincerely

Dr M.J. McLaughlin

Dr M.J.McLaughlin

National Cadmium Coordinator/Research Group Leader

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http://www.waite.adelaide.edu.au/Soil_Water/McLaughlin/MikeMc%20Laugh.html